

# Variation in nest temperatures of the American Alligator found on the Kennedy Space Center / Merritt Island National Wildlife Refuge

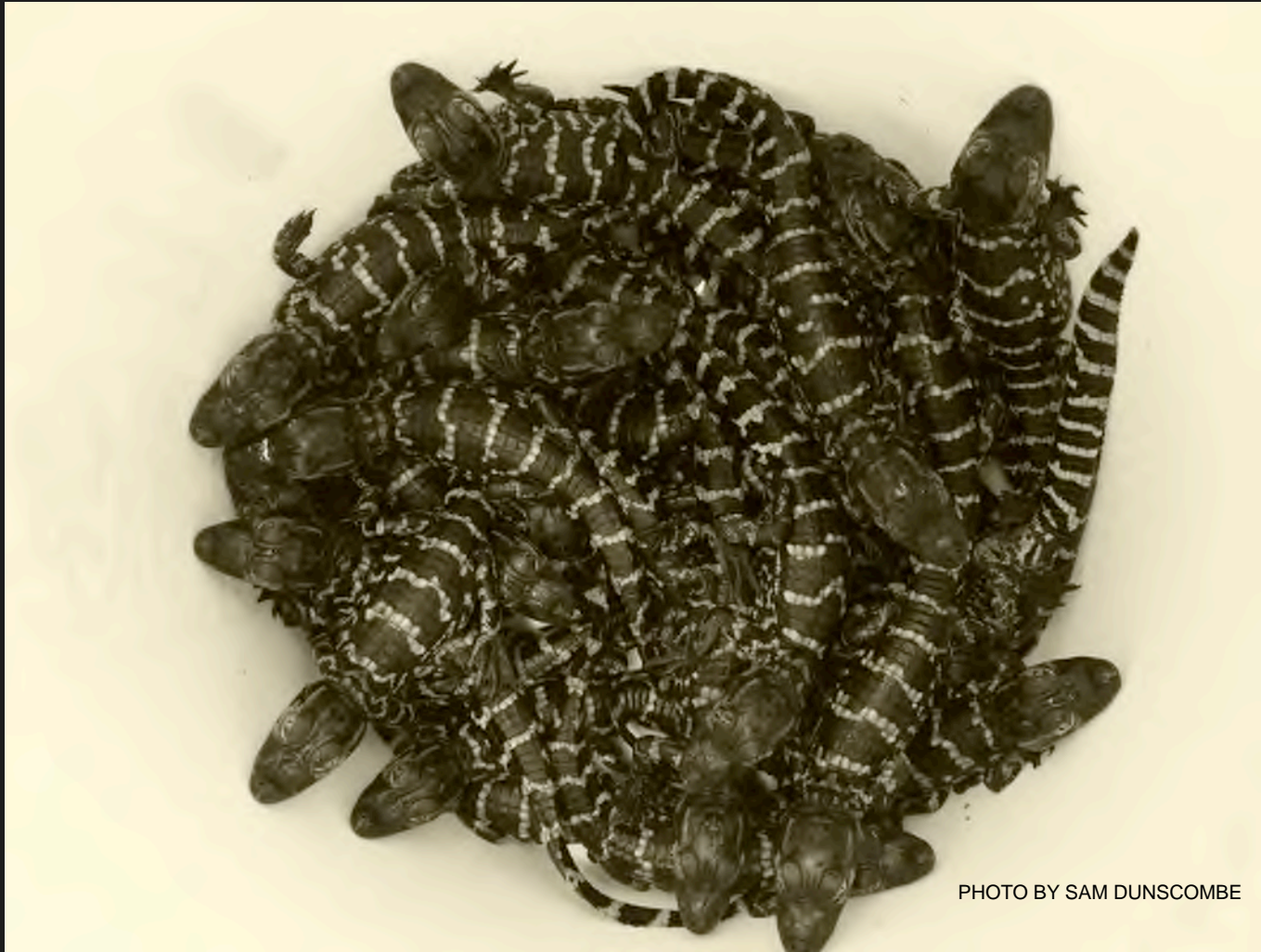


PHOTO BY SAM DUNSCOMBE

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↓ Kennedy Space Center





# **56,656 ha or 140,000 acres**

**32,374 ha (80,000 acres) land**

**24,281 ha (60,000 acres) water**

# WHY ARE NESTING TEMPERATURES IMPORTANT?

- **Temperature Sexual determination**
  - FEMALES 29 deg C 50/50 31.5 deg C MALES 34 deg C
- **Recruitment / Population structure**
- **Sea level rise / Global warming**
- **Provide information for long term management decisions**

MINWR  
NASA  
CNS  
Other agencies

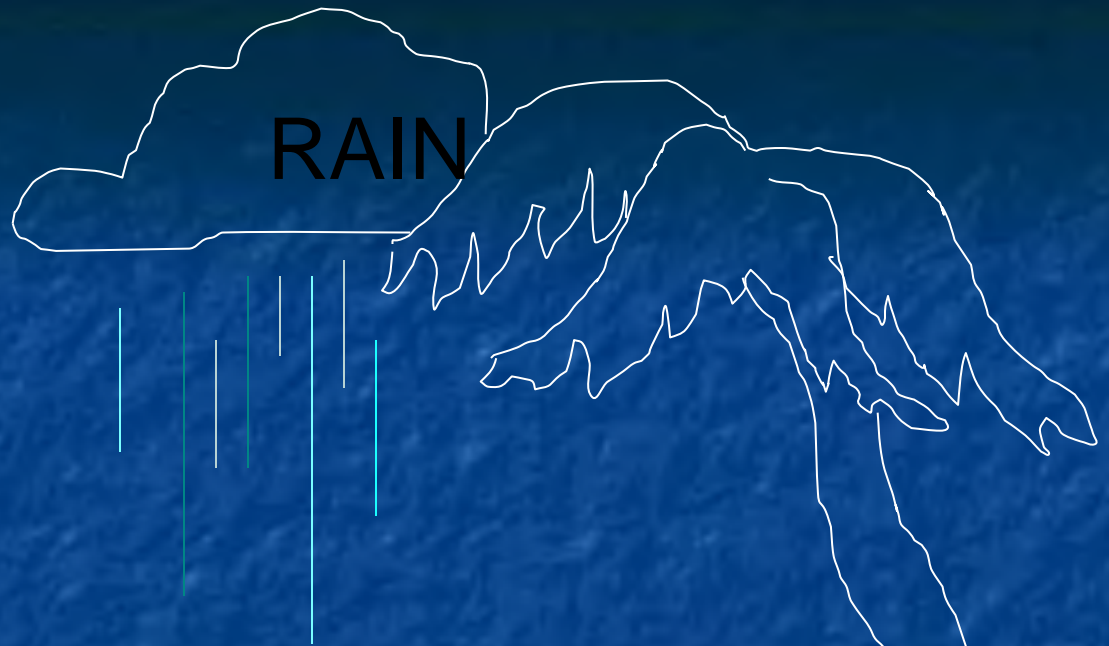




# OBJECTIVES

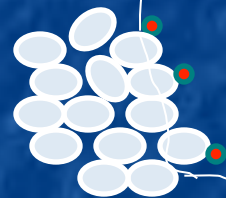
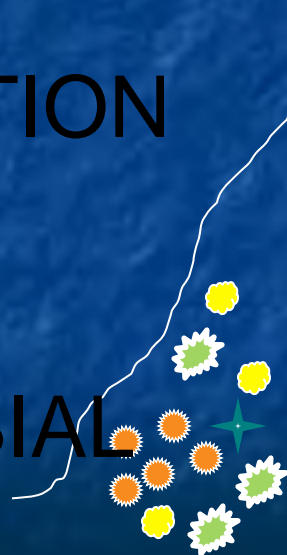
- IMPLANT 3 THERMISTERS IN EGG CAVITY NEXT TO THE EGGS, RECORDING DEPTH, LOCATION AND TIME
- PUT A THERMISTER IN THE AIR NEXT TO THE NEST
- PULL EGGS FOR STAGING
- THERMISTERS SET TO LOG EVERY 5 MINUTES
- RECORD TIME WHEN THEY ARE PICKED UP





VEGETATION  
COLOR

MICROBIAL  
ACTION



SHADE

COMPOST TYPE  
(VEGETATION)





















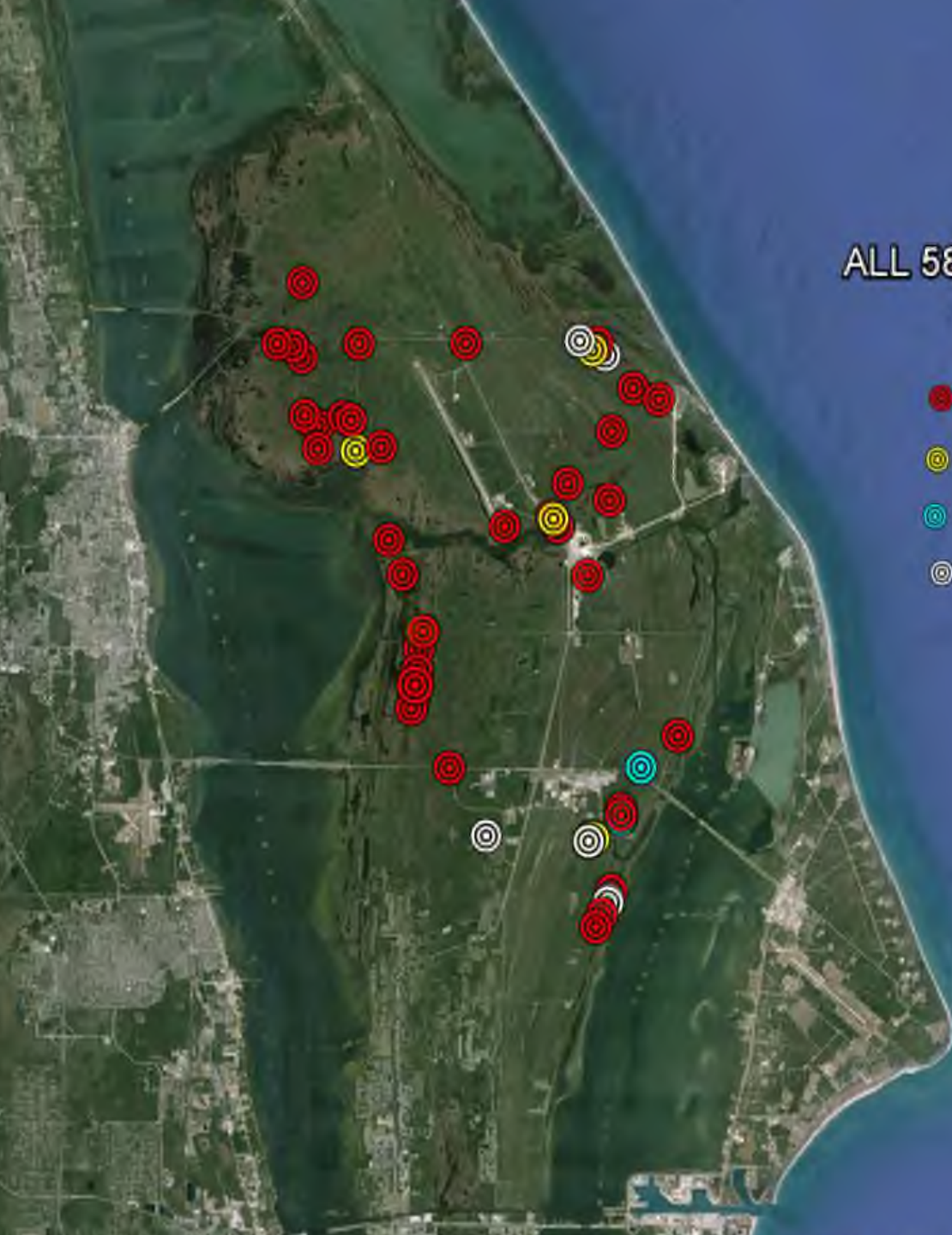






## ALL 58 NESTS 2010 - 2015

- NORMAL HATCHED NEST
- UNKNOWN IF HATCHED
- DEPREDATED NEST
- DEAD NEST









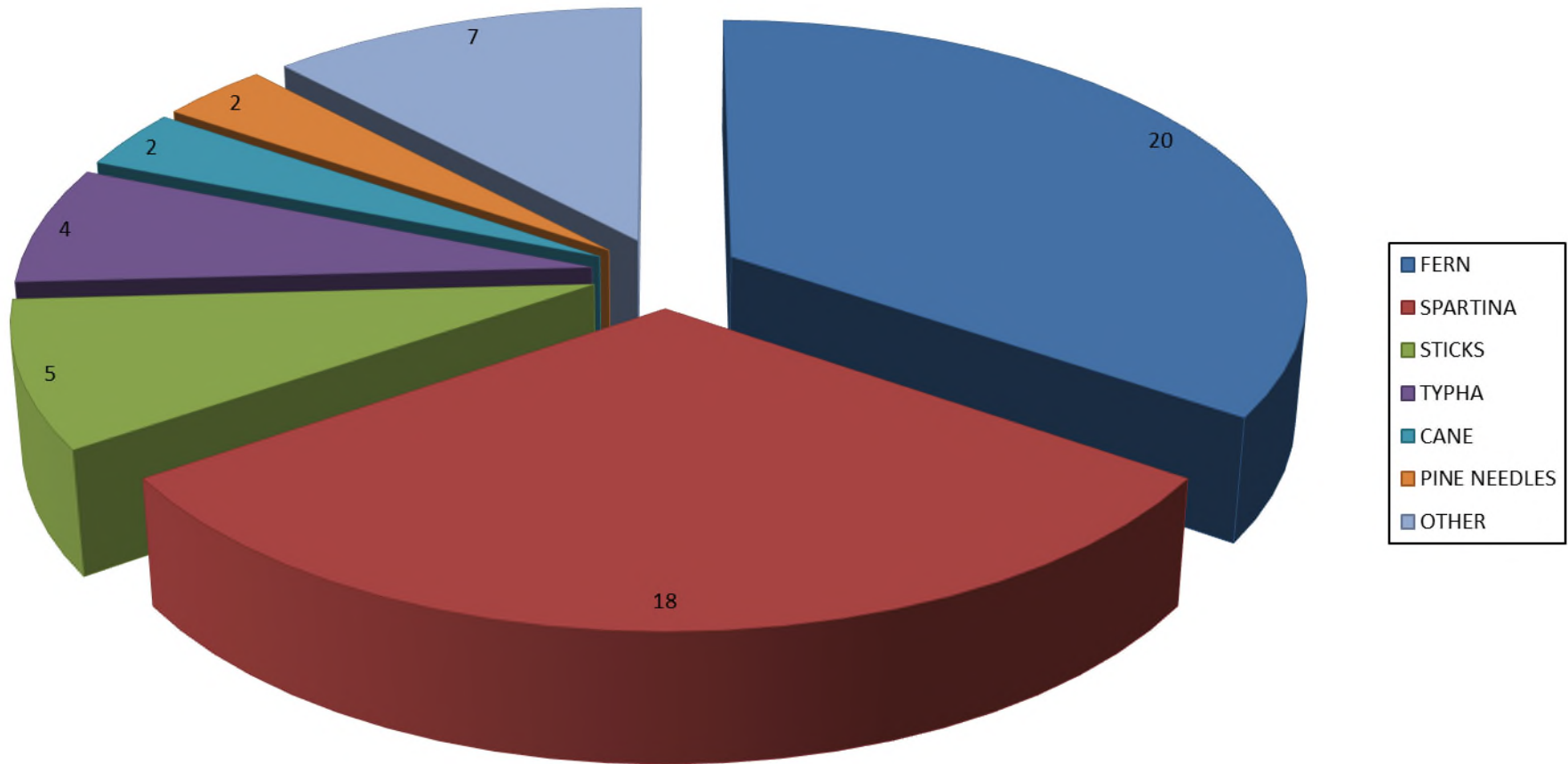






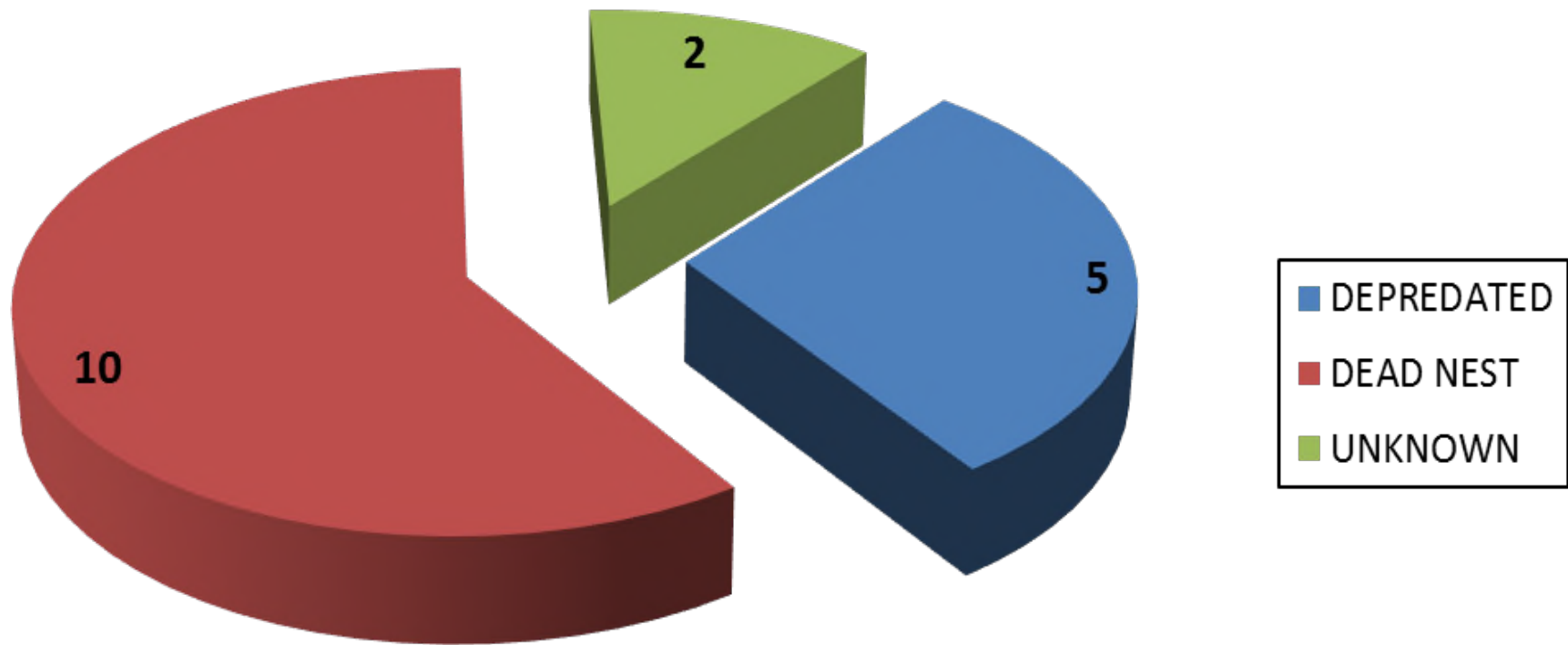


# VEGETATION TYPES



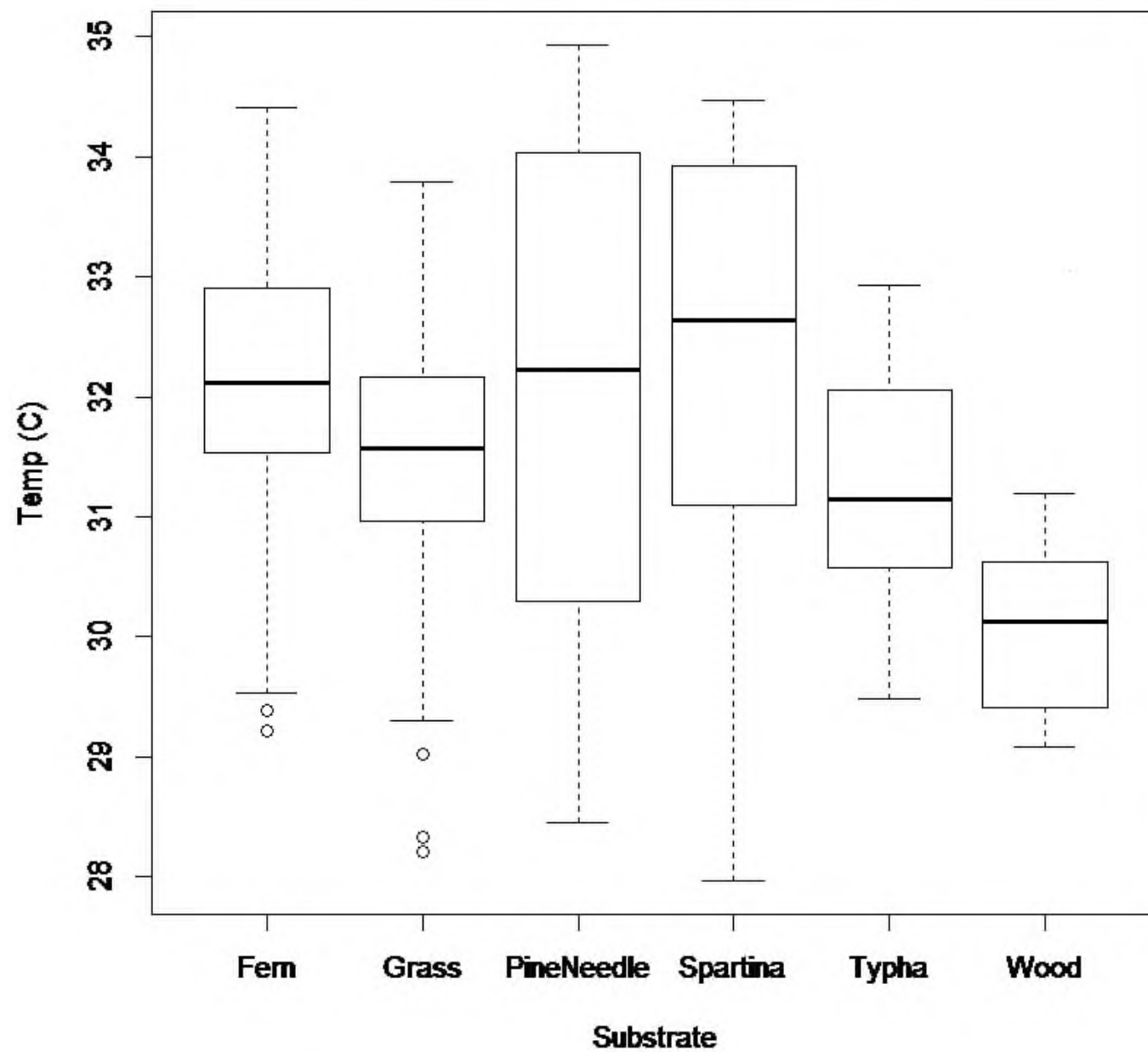


## THERMISTER NESTS THAT DID NOT HATCH 2010 - 2015



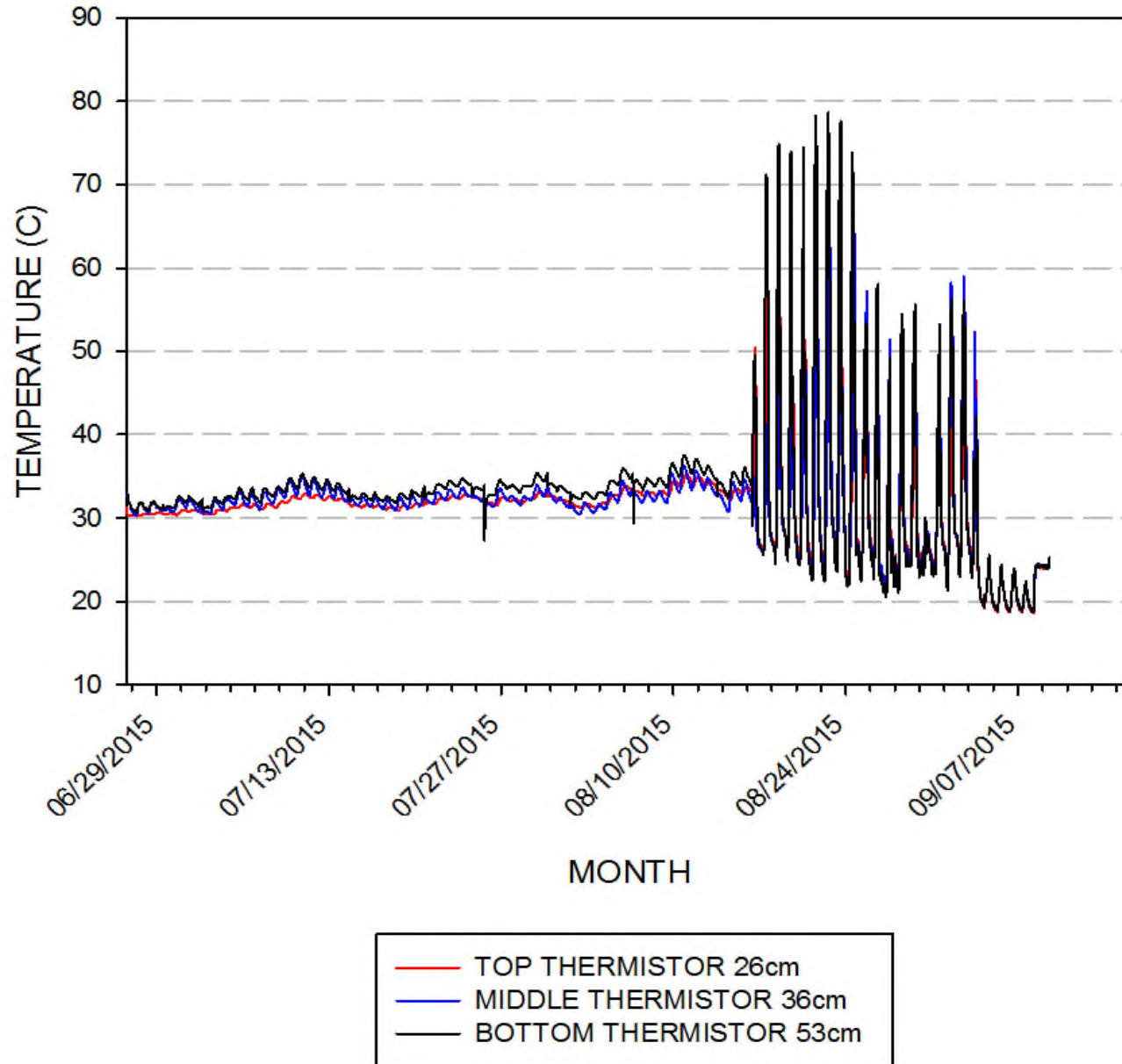


**Average TSD Temperatures**





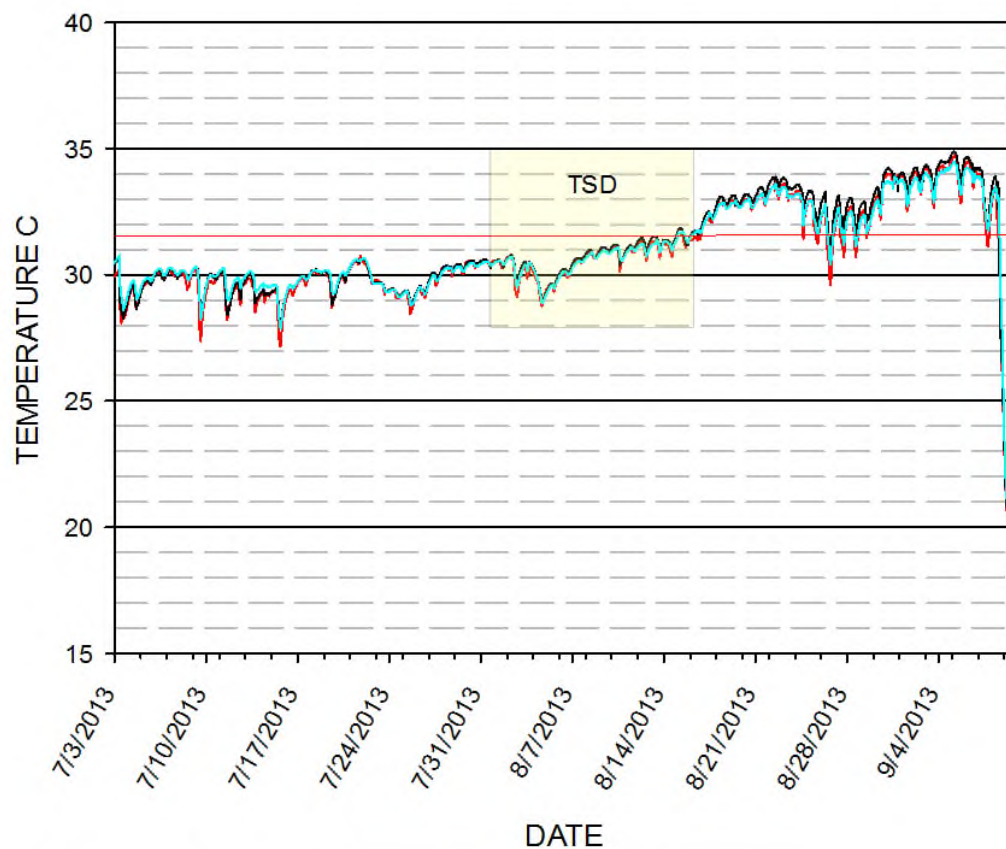
## DMS 4 THERMISTORS 2015





60

THERMISTERS 2013  
GRAPH 6  
(HATCHED)  
FERN 90%

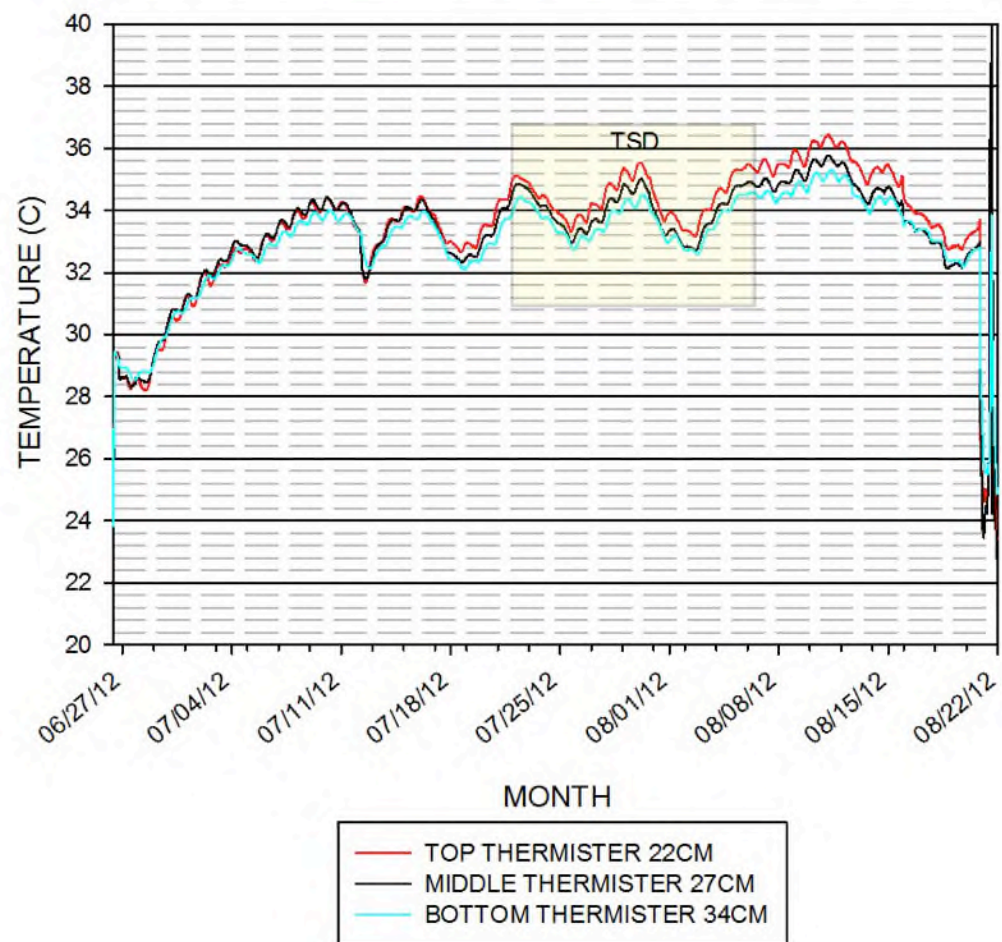


7

— TOP THERMISTER 18CM  
— MIDDLE THERMISTER 20CM  
— BOTTOM THERMISTER 27CM

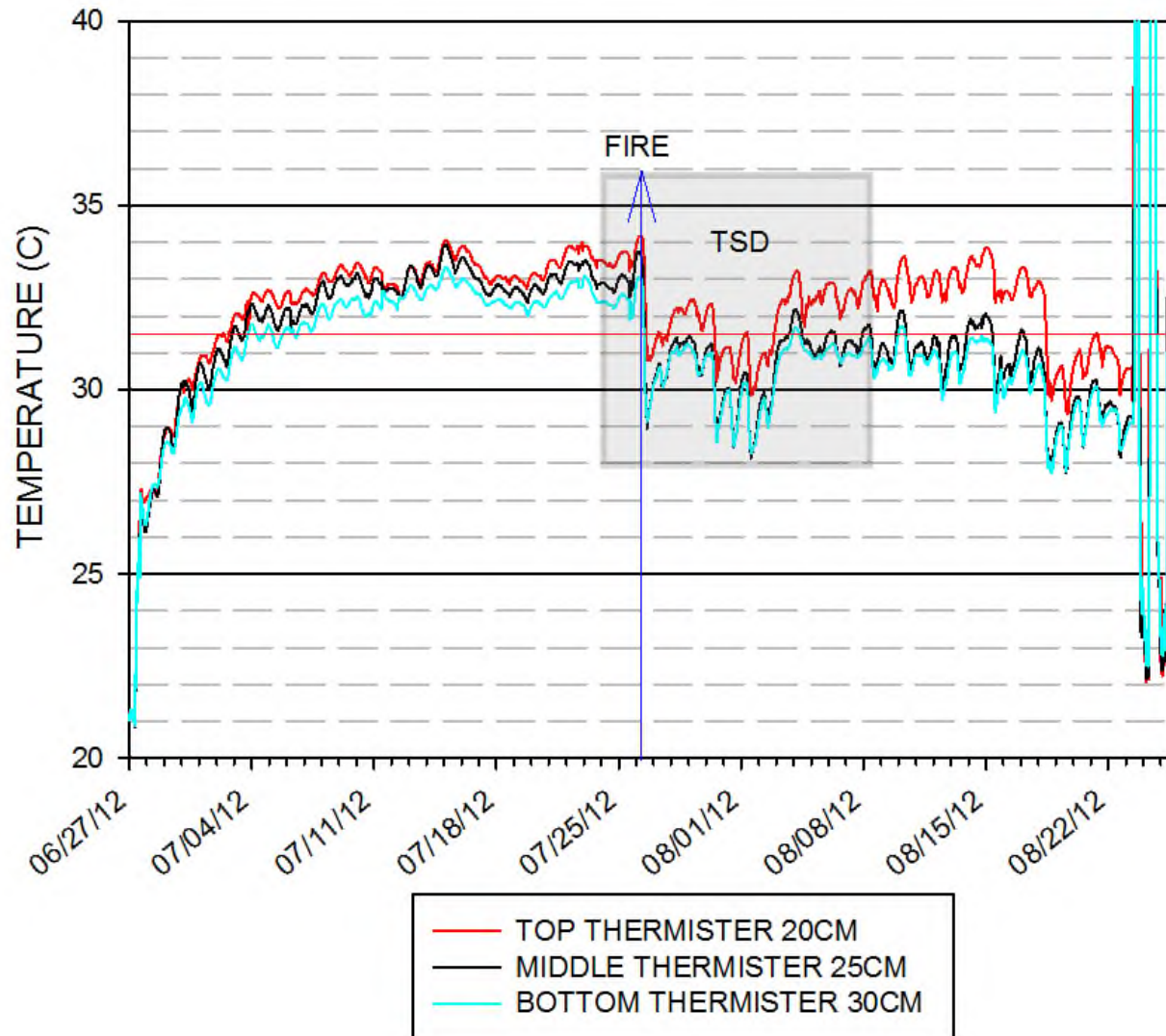


NEST RHL 01 2012  
HATCHED / PINE NEEDLES



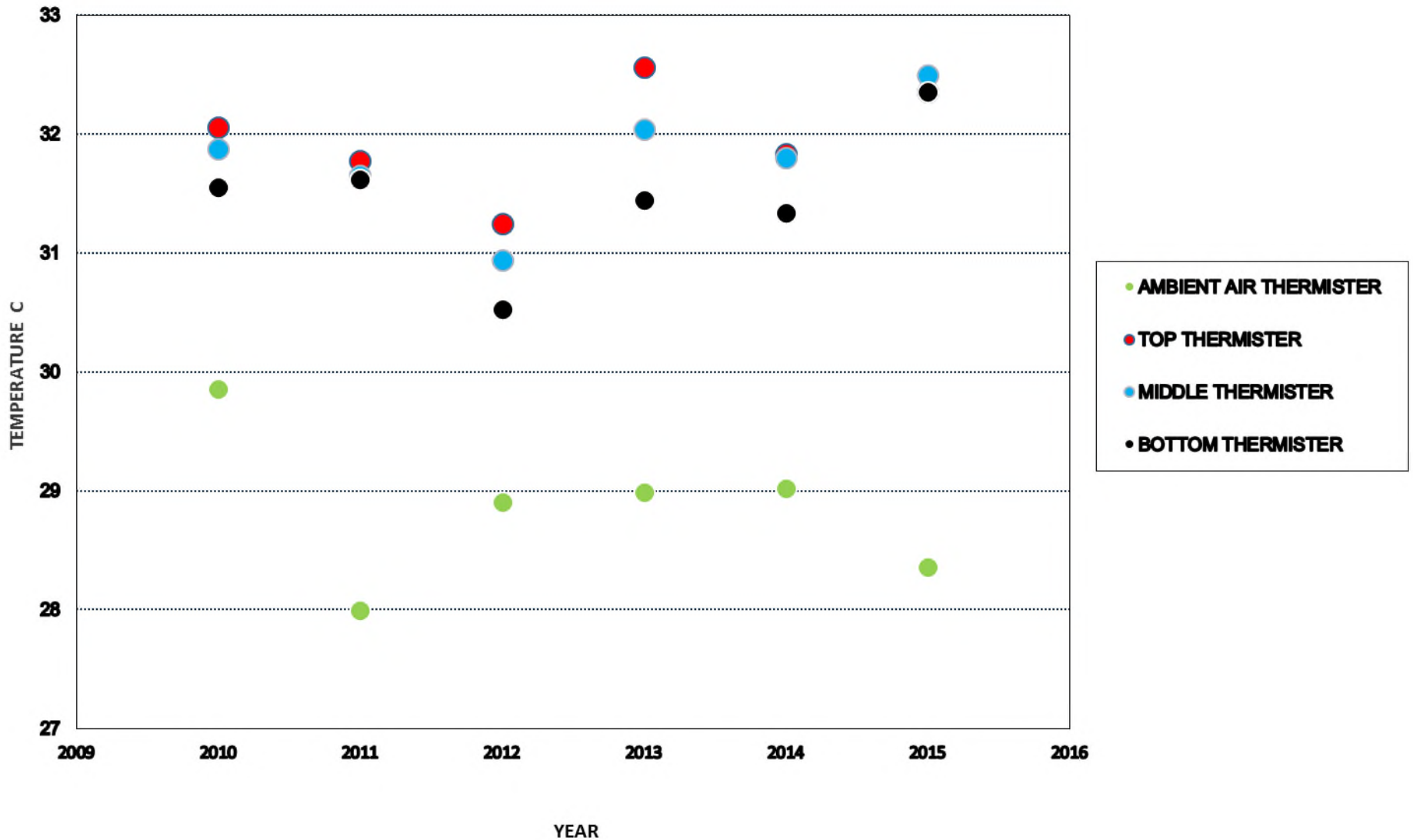


NEST PD1 2012  
HATCHED / SPARTINA



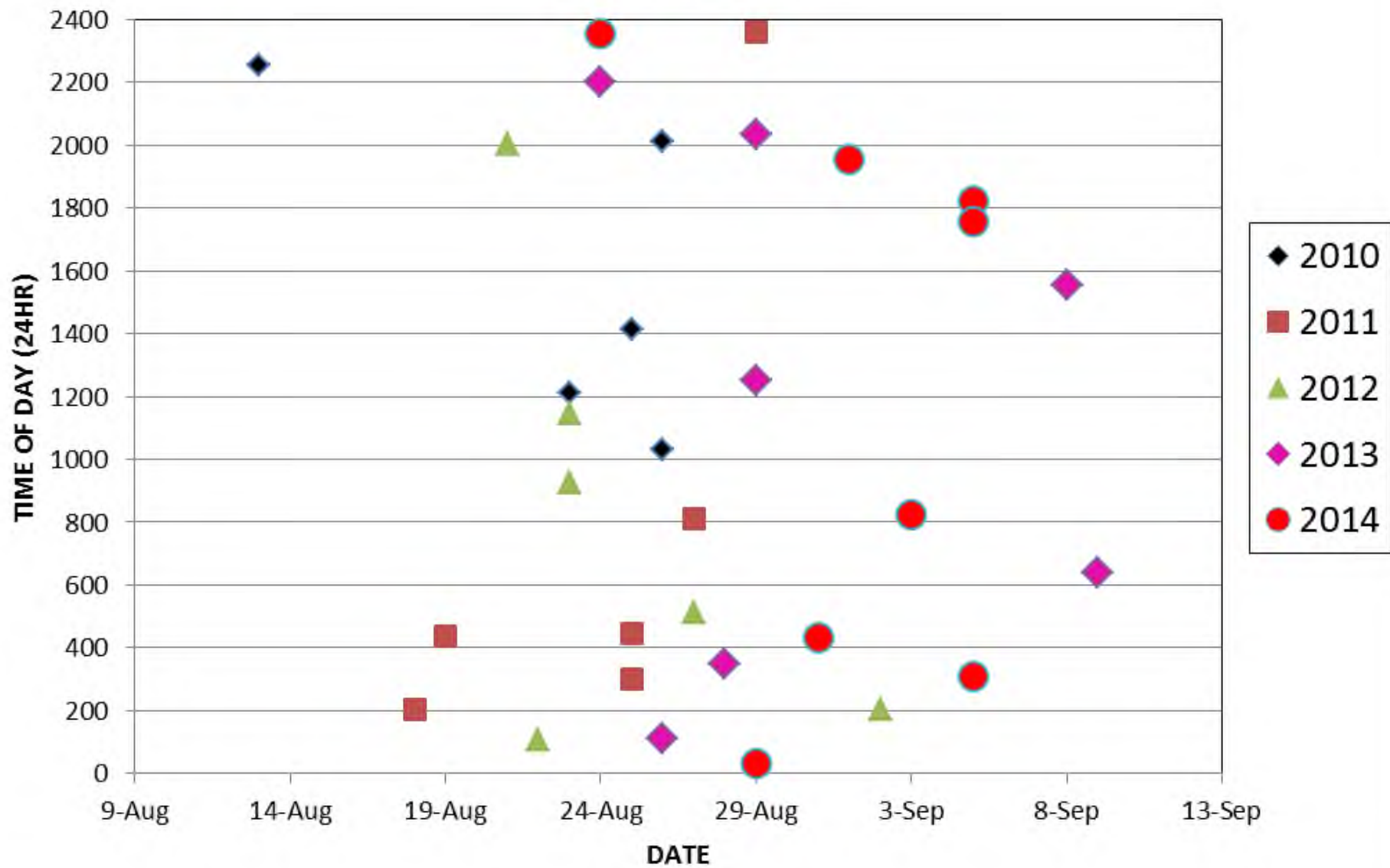


## AVERAGE TEMPERATURE DURING TSD

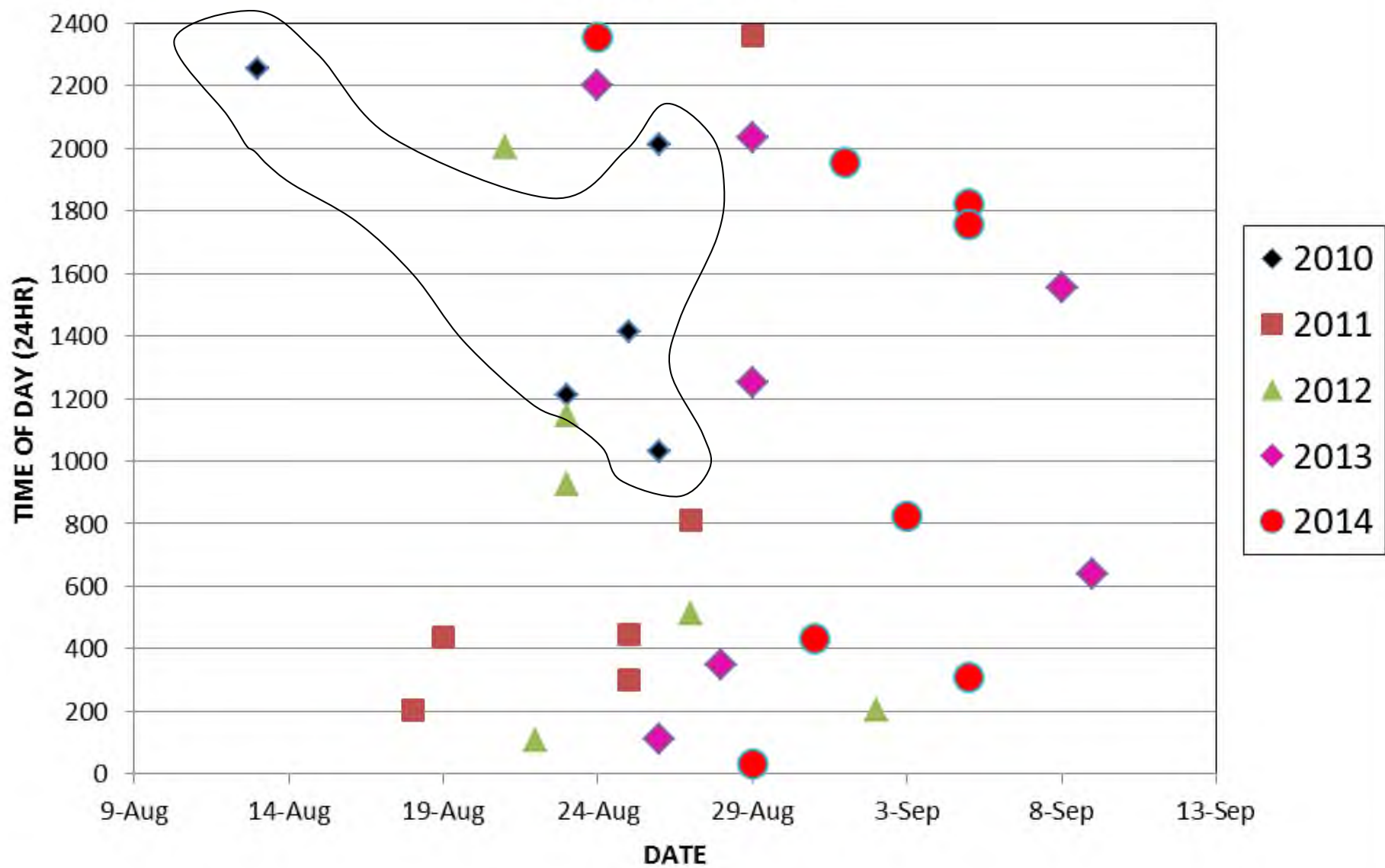




# DAY AND TIME OF HATCHING 2010 - 2014

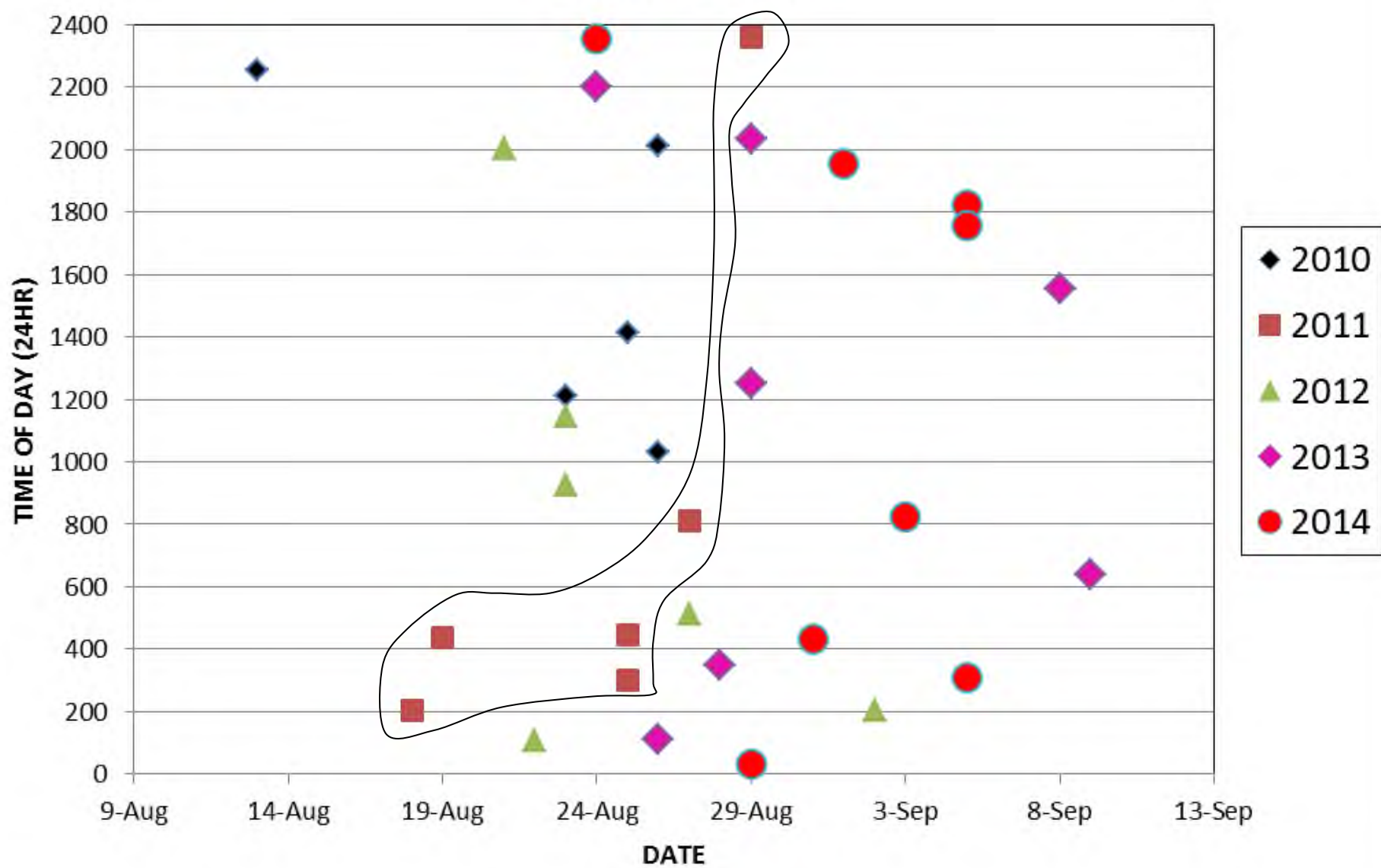


# DAY AND TIME OF HATCHING 2010 - 2014

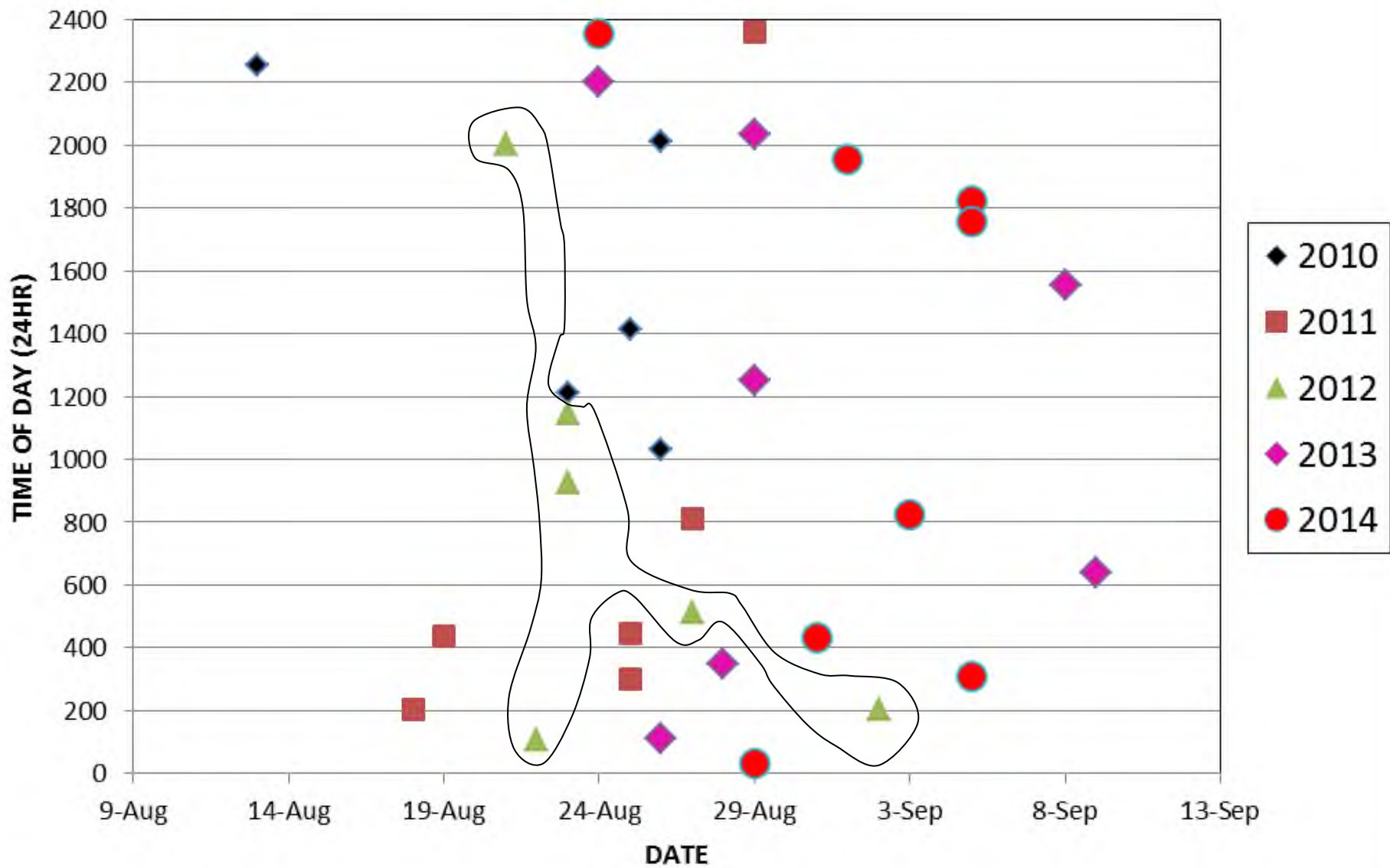




# DAY AND TIME OF HATCHING 2010 - 2014

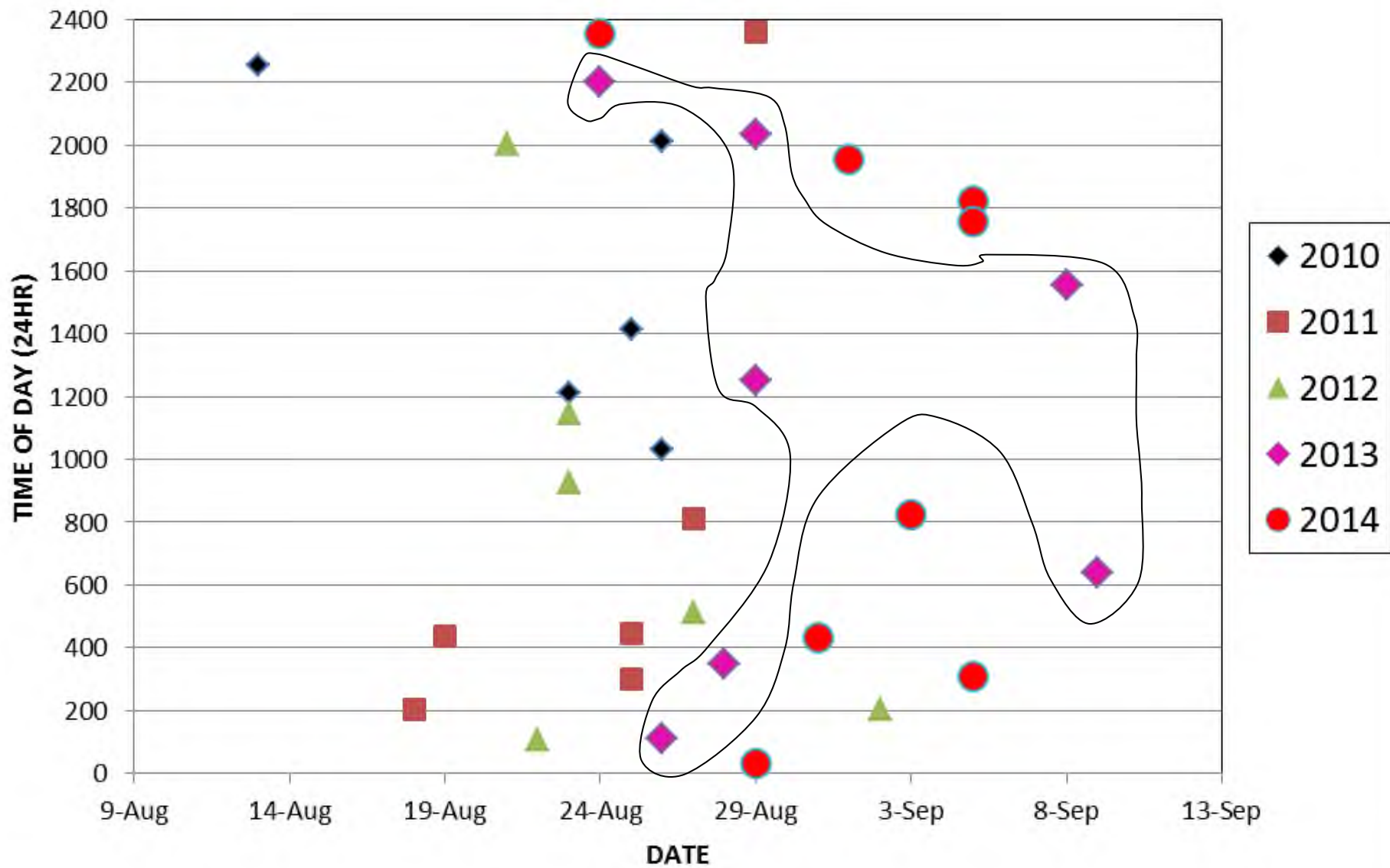


# DAY AND TIME OF HATCHING 2010 - 2014

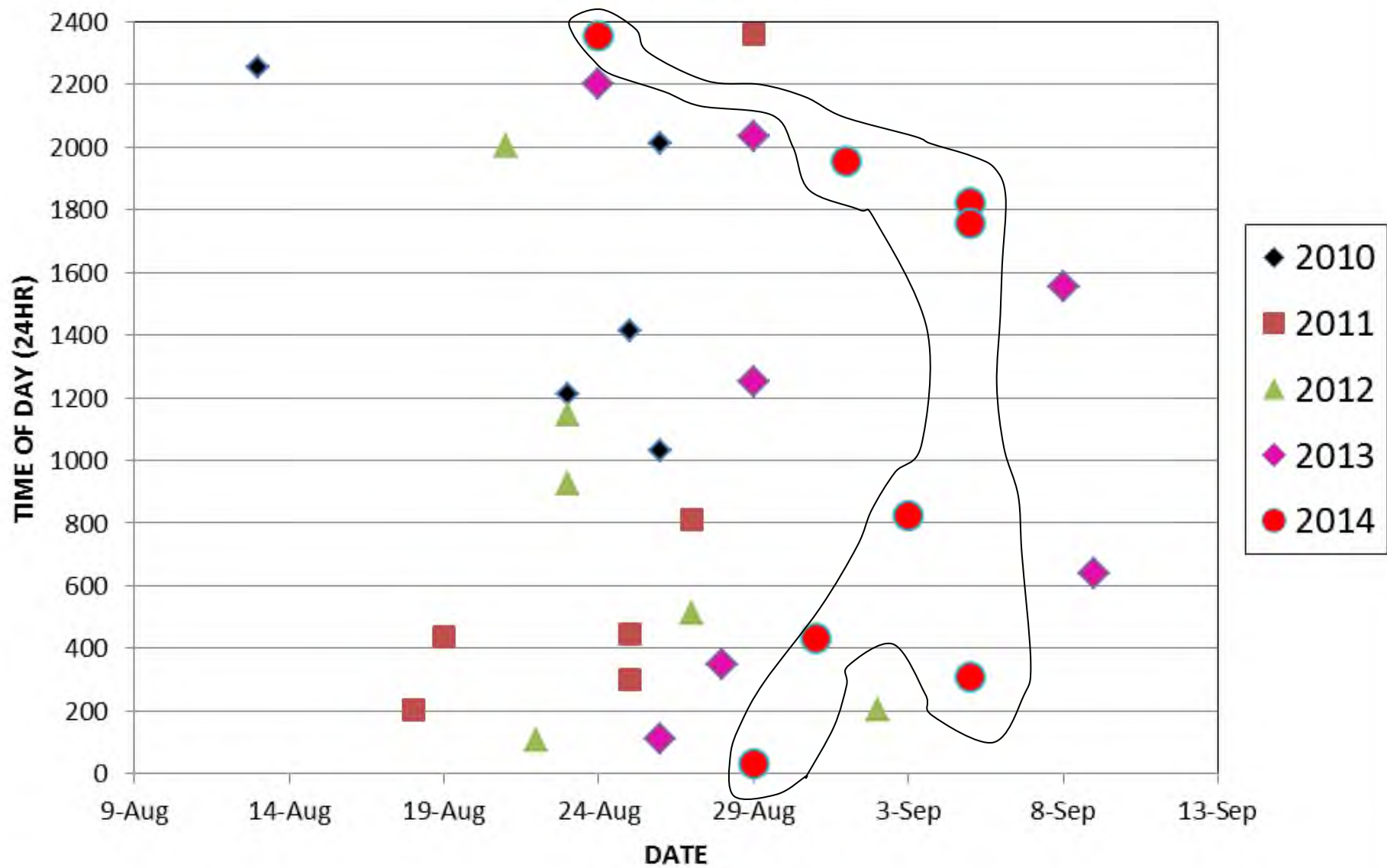




# DAY AND TIME OF HATCHING 2010 - 2014

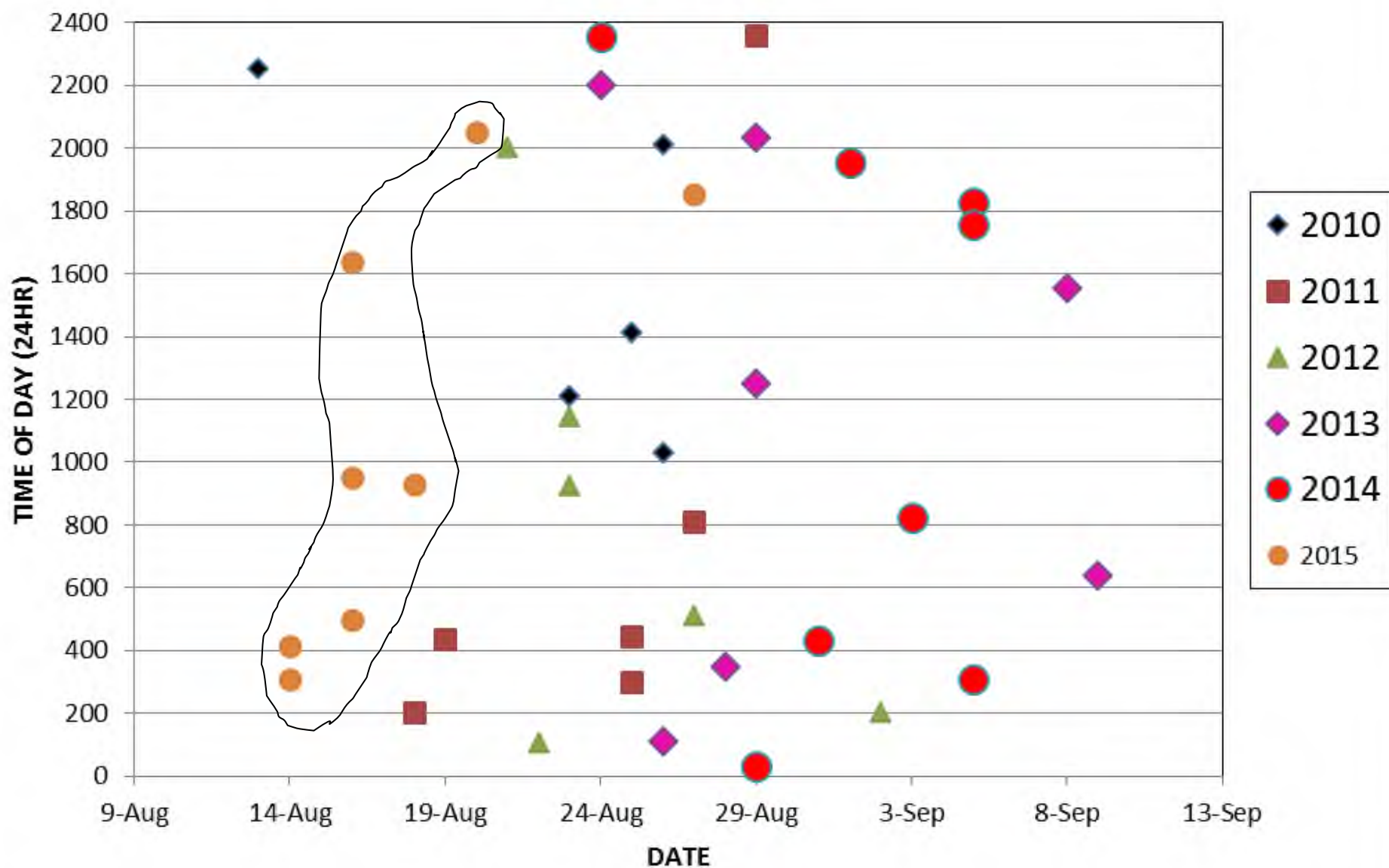


# DAY AND TIME OF HATCHING 2010 - 2014

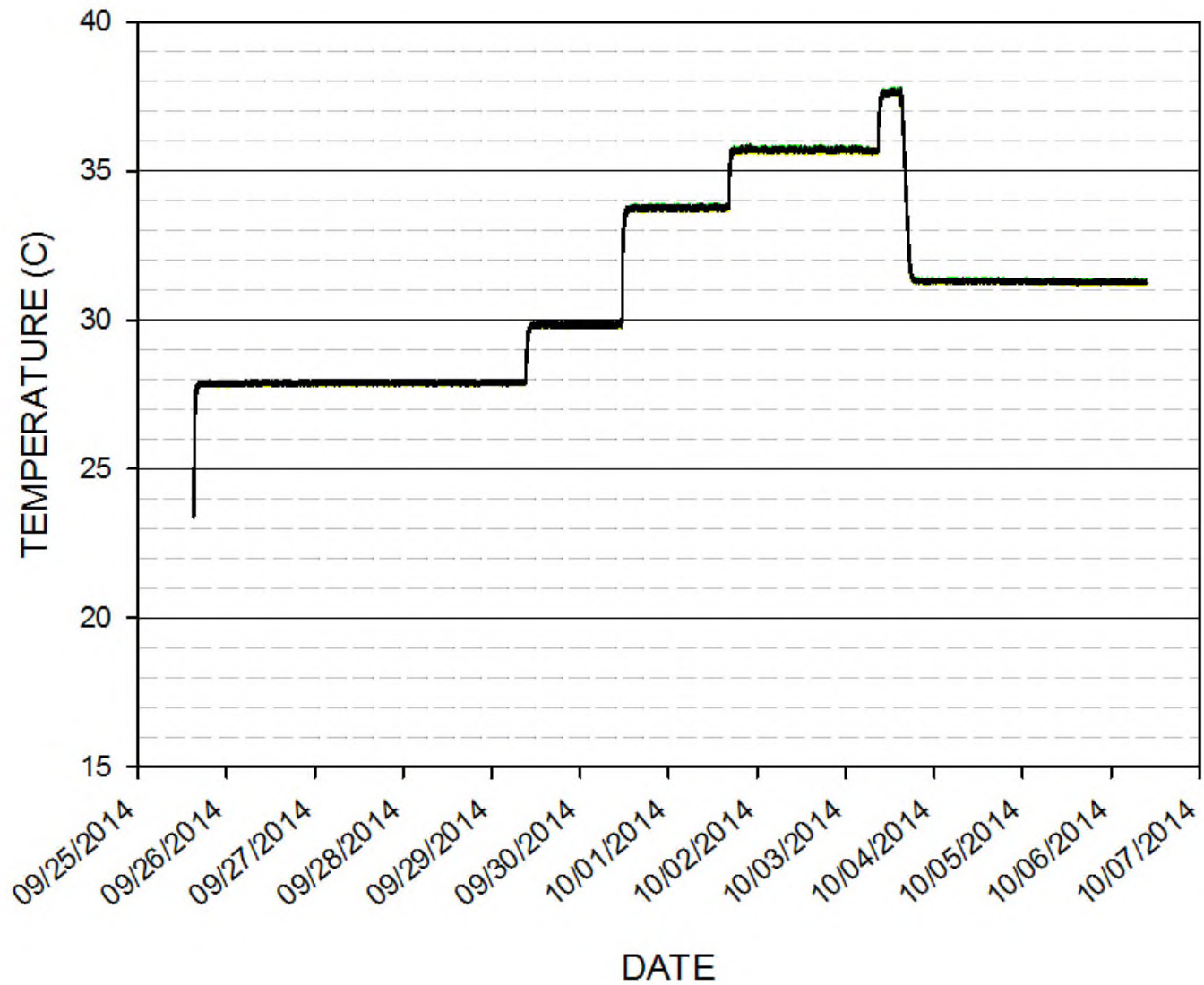




# DAY AND TIME OF HATCHING 2010 - 2015



# THERMISTER CALIBRATION





# WILD NEST TEMPERATURE RESULTS

- 58 Nests with temperature data loggers
- 41 Nests hatched (71%)
- Average temperature in the alligator nests at TSD was 31.8 deg. C. indicating our recruitment here is close to 50/50
- Range between the three different depth temperatures at sexual determination was only .27 deg. C
- Rain had a big influence on the alligator nests dropping the temperature up to eight deg. C.
- Highest temperature recorded was 78.5 deg C (173 deg F).  
Was a thermistor on the ground after hatching. Yes the swamp is HOT!

# Overall summary

- High nesting success on KSC/MINWR
- TSD temperatures close to 50;50 for male to female ratio



# Publications

- ❑ Hamlin, H. J., R. H. Lowers, L. C. Albergotti, M. W. McCoy, J. Mutz, and L. J. Guillette.. Environmental Influence on Yolk Steroids in American Alligators (*Alligator mississippiensis*). *Biology of Reproduction*. 2010, 83:736-741.
- ❑ Boggs, A. S. P., H. J. Hamlin, R. H. Lowers, and L. J. Guillette Jr.. Seasonal variation in plasma thyroid hormone concentrations in coastal versus inland populations of juvenile American alligators (*Alligator mississippiensis*): Influence of plasma iodide concentrations. *General and Comparative Endocrinology*. 2011, 174:362-369.
- ❑ Hamlin, H. J., R. H. Lowers, and L. J. Guillette. Seasonal Androgen Cycles in Adult Male American Alligators (*Alligator mississippiensis*) from a Barrier Island Population. *Biology of Reproduction*. 2011, 85:1108-1113.
- ❑ Bowden, J. A. , B A. Nocito, R H. Lowers, L J. Guillette, Jr., K R. Williams and V.Y. Young,, Environmental indicators of metal pollution and emission: an experiment for the Instrumental Analysis Laboratory. *J. Chem. .Educ.* 2012, 89 (8), 1057–1060
- ❑ Watanabe Y.Y., Reyier E.A., Lowers R.H., Imhoff J.H., Papastamatiou Y.P., Behavior of American alligators monitored by multi-sensor data loggers. *Aquatic Biology*. 2013, Vol. 18: 1–8,
- ❑ Boggs, A.S.P., Lowers R.H., Cloy-McCoy J.A., Guillette L.J.Jr., Organizational Changes to Thyroid Regulation in *Alligator mississippiensis*: Evidence for Predictive Adaptive Responses. *Plos One* 8, (2013) 1-9
- ❑ Nifong J. H, Nifong R.L., Silliman B.R., Lowers R.H.,Guillette L.G. Jr.,Jake M. Ferguson<sup>1</sup>, Matthew Welsh<sup>5</sup>, Kyler Abernathy<sup>6</sup>, Greg Marshall<sup>6</sup>Animal-Borne Imaging Reveals Novel Insights into the foraging Behaviors and Diel Activity of a Large-Bodied apex Predator, the American Alligator (*Alligator mississippiensis*).*PLOS ONE* January 2014.,9 ;1

- ❑ Heather J Hamlin<sup>1,2,\*</sup>, Russell H Lowers<sup>3,\*</sup>, Satomi Kohno<sup>1,10</sup>, Naoko Mitsui-Watanabe<sup>4</sup>, Haruna Amano<sup>5,6</sup>, Akihiko Hara<sup>5</sup>, Yasuhiko Ohta<sup>7</sup>, Shinichi Miyagawa<sup>8,9</sup>, Taisen Iguchi<sup>8,9</sup> and Louis J Guillette Jr . 2014 The reproductive hormone cycle of adult female American alligators from a barrier island population. *Reproduction* (2014) 147 855–863
- ❑ Myburgh, J.G., Kirberger, R.M., Steyl, J.C.A., Soley, J.T., Boyse, D.G., Huchzermeyer, F.W. *et al.*, The post-occipital spinal venous sinus of the Nile crocodile (*Crocodylus niloticus*): Its anatomy and use for blood sample collection and intravenous infusions, *Journal of the South African Veterinary Association* 2014 85(1), Art. #965, 10 pages.
- ❑ Sawako Horai, Takaaki Itai, Takako Noguchi, Yusuke Yasuda, Haruki Adachi, Yuika Hyobu, Adi S. Riyadi, Ashley S.P. Boggs, Russell Lowers, Louis J. Guillette Jr., Shinsuke Tanabe, Concentrations of trace elements in American alligators(*Alligator mississippiensis*) from Florida, USA *Chemosphere* 108 (2014) 159–167





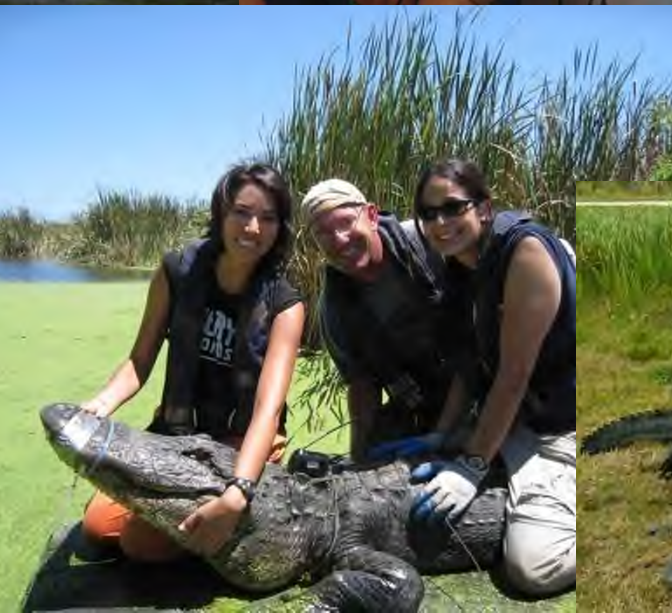
## **SPECIAL THANKS TO:**

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- **USFWS Gainesville: Allen Woodward, Cameron Carter, Patrick Delaney, Arnold Brunell**
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- **Center for Marine Environmental Studies (CMES) Japan**
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**ANY QUESTIONS?**

